DEMAND FOR GASOLINE: EFFECTS OF A DURABLE GOOD

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I. INTRODUCTION

Recently, the question of changes in gasoline prices has assumed increasing importance because of its believed impact on gasoline consumption. This paper estimates empirical demand functions for premium gasoline as well as for new cars with particular attention to the effects of changes in gasoline prices.

More specifically, the paper tries to determine the effectiveness of policies designed to conserve gasoline not only by considering the effects of changes in gasoline prices on the demand for premium gasoline, but also by attempting to take into account the differential effect of these changes on the size composition of the existing stock of automobiles. Any shift in consumer tastes and preferences away from larger cars towards smaller ones produced by the changes in gasoline prices is significant because of the differential fuel economy and long-run impact on fuel consumption of the different size classes of cars.

II. DATA, HYPOTHESIS, AND APPROACH

The empirical analysis is based on an annual series of observations for the period 1970-79. This sample is not ideal; however, data limitations preclude the use of either quarterly observations or a longer annual series of data for the analysis.

Separate demand equations for cars and for gasoline are estimated in the study. For the analysis of automobile demand, a demand function for cars using the market share approach is utilized. Separate market share equations for each size class of car, i.e., small (under 1300 cc engine displacement), subcompact (between 1400 cc and 1600 cc) and large (between 1700 cc and 2000 cc), are estimated. The ratio of new cars sold for each size class to the total number of

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cars sold represents the dependent variable in the car equations.

Separate data for every specific car brand name could have been used throughout the analysis. However, the change of brand names that has occurred since 1970 would lead to a problem of interpretation of the equation estimates. Moreover, by grouping the data across brand names, the possibility of seeing a policy act upon specific car brand names instead of general car characteristics such as size or weight is eliminated.

As stated above, the separation of cars into three classes is primarily done by size representing the distinction between a small car, subcompact and large car. This deserves further explanation. First of all, these are the models that the Progressive Car Manufacturing Program produces. But more important is the fact that consumer demand response to higher gasoline prices may have time lags because of the lifetime of the existing stock of cars and because of consumers' unwillingness to abandon subjective preferences (Blomqvist and Haessel 1978). According to Blomqvist, motorists may meet the increase in fuel cost by curtailing expenditures it considers as more discretionary than car travel in the short run. In the long run, higher gasoline prices could significantly diminish gasoline consumption through reduced purchases of new cars and shifts in consumer tastes and preferences from larger cars to smaller ones.

The general hypothesis suggested is that consumer demand for new cars results from movements in real disposable income (Y_d), the real price of new car (P_c), the real retail price of premium gasoline (P_g) and the total number of cars in operation (C_p). The equation incorporating all of these influences is as follows:

$$\log M_i = b_1$$

$$\log M_i = b_1 + b_2 \log Y_d + b_3 \log P_e + b_4 \log P_g + \log C_p$$

where

M_i = market share of each car size i,
i = 1 (under 1300 cc), 2 (between 1400 cc and 1600 cc) and 3 (above 1700 cc).
Y_d = real disposable income
P_g = real retail price of premium gasoline
P_c = real price of new car
C_p = total car population

All of the equation estimates are log-linear with the coefficients measured as elasticities. The variable for P_c is a weighted average price with no distinction between car types or brands. An increased price may indeed cause a shift away from the larger cars (1400 cc to 1600 cc and above 1700 cc) to the smaller, mini-subcompact cars (below 1300 cc). Therefore, the regression coefficient for the larger cars are expected to be negative while those for the smaller (mini-subcompact) ones are expected to be positive.

The price of premium gasoline is expected to have a negative sign. Likewise the regression coefficient for C_p is expected to have a negative sign. The main assumption here is that cars wear out and that new cars replace the old or scrapped ones. An increase in the total number of cars in operation implies in part that fewer cars are scrapped. Therefore, the demand for new cars should fall.

As for the analysis of gasoline demand, the critical explanatory variable is its own price (P_g). This is given prominent attention in the paper later. Suffice it to say at this stage that the regression coefficient for gasoline price is expected to have a negative sign. The other explanatory variables in the gasoline demand equations are real disposable income (Y_d), total car population (C_p), and the average size of the existing stock of automobiles (S_c), all of which are expected to have a positive effect on gasoline consumption (G).[1] The equation incorporating all of these influences is as follows:

$$\log G = b_1 + b_2 \log Y_d + b_3 \log P_g + b_4 \log C_p + b_5 \log S_c$$

where

G = gasoline consumption
Y_d = real disposable income
P_g = real retail price of premium gasoline
C_p = total car population
S_c = average size of the existing stock of cars

As in the car demand equations, all equation estimates for gasoline demand are log-linear with the coefficients measures as elasticities.

III. REGRESSION RESULTS

Using annual data for the period 1970-79 and employing log-

1. To judge the effect of car size on gasoline consumption, each car class i = 1, 2, 3 is weighted by their respective market shares to obtain a market weighted average size of cars.

linear estimates, car demand model I (cars with 1300 cc engine or less) is tested for the influence of Y_d, P_c, P_g and C_p. As seen in Appendix Table 1, the corrected R^2's for all the equations are rather high and the standard error of the regression S_c is low.[2] In equations 1.1, 1.2 and 1.3, the coefficients for P_c, P_g and C_p are correctly signed; however, only that for P_c differs significantly from zero at the 1 percent level (C_p is statistically significant at the 10 percent level in 1.3). The coefficient for Y_d, on the other hand, is not correctly signed in 1.1 and 1.3 though it has a correct sign in 1.2, 1.4 and 1.5. It must be noted, though, that the coefficients for Y_d do not differ significantly from zero in these equation tests.

To investigate further the stability of the relationship between the dependent variable and the independent variables, six other regression equations are tested (1.6 through 1.11), with each equation containing different combinations of independent variables. The results of P_c exhibit considerable stability in these equation tests, i.e., the sign remains positive and the t-ratio is statistically significant at the 1 percent level. The coefficients for P_g and C_p, in contrast, while exhibiting correct signs, do not have statistically significant t-ratios (except in 1.11 where P_g is significant, and in 1.7 where C_p is significant). On the other hand, the sign of the coefficient for Y_d becomes consistently positive in 1.9 and in 1.10 except that the acceptance region for the hypothesis that the regression coefficient does not differ significantly from zero varies widely, i.e., it is significantly different from zero at the 1 percent level in 1.9 but is not different from zero at either the 5 or 10 percent levels in 1.10.

These unstable results are indeed symptomatic of multicollinearity. This is suggested by the correlation matrix (Appendix Table 5) which shows a larger correlation between Y_d and C_p than that between either Y_d or C_p and the dependent variable. A simpler yet more accurate way of telling whether multicollinearity is present, however, is to examine the individual standard errors (Pindyck and Rubinfeld 1976). For example, the standard errors of Y_d and C_p vary considerably as either Y_d or C_p is dropped from the regression equations. The multicollinearity problem, however, could be due to the very small sample obtained for the analysis. As mentioned previously, a serious limitation of the study is its inability to obtain a

2. The DW statistic is not tested on account of the small number of degrees of freedom. Homoscedasticity, on the other hand, is assumed to hold since the observations involve aggregates over time (Kmenta 1971).

longer series of data. This is important because any new data may cause the multicollinearity problem to disappear or at least temper its effects (Pindyck and Rubinfeld 1976).

In these equation tests, one may note that the regression coefficient for P_c is stable in every case (1.1 to 1.11).[3] This is worthy of special notice because it indicates a large positive effect on the demand for cars of the type specified in the analysis. This means that, as the general price of cars rises, the demand for small cars increases.

The findings for Y_d, C_p and P_g in these equation tests, on the other hand, are less clear. However, one may consider equations 1.9, 1.7 and 1.11, where the coefficients for Y_d, C_p and P_g have, respectively, the expected signs and statistically significant t-ratios at the 1 percent level. Of these, the results of P_g and C_p are the most interesting. The findings for P_g and C_p suggest that, given a reduction in the purchases of small cars as a result of increases in the price of gasoline, the average age of cars will increase in the future as fewer cars are scrapped (all other things remaining equal).

Using the same data series and estimation technique employed above, car demand model II (cars between 1400 cc and 1600 cc) is now tested for the influence of the same set of explanatory variables. As seen in Appendix Table 2, only the car price variable has a consistently negative coefficient, as expected, and it differs significantly from zero at the 1 percent level. The coefficients for all the other explanatory variables either do not have the expected signs or do not have statistically significant t-ratios. Y_d and P_g are rejected on economic grounds because of an incorrect sign while C_p is rejected on statistical grounds on account of an insignificant t-ratio. Thus, in all of the equation tests (2.1 to 2.15), only the car price variable can be supported on both economic and statistical grounds. It suggests that, as the general price of cars increases, the demand for new cars of the class specified under this equation set, declines.

Car demand model III (for cars with over 1700 cc engines) is likewise tested and the results of these tests are shown in Appendix Table 3. In these tests, it is distressing to note that none of the explanatory variables perform satisfactorily (except for Y_d which is correctly signed and statistically significant at the 10 percent level in

3. Note that the fact that the coefficient for the car price variable P_c is stable suggests that the results are not distorted by multicollinearity.

3.4 and 3.5).[4] In these tests, no evidence is found that supports either the P_c, P_g and C_p hypothesis on account of either an incorrect sign or a statistically insignificant t-ratio. The implication of these findings is that the demand for large cars is largely insulated from increases in the prices of either cars or gasoline.

As for the analysis of gasoline demand (Appendix Table 4), the strong positive effect of cars in operation is apparent. the estimated coefficient for C_p is reasonably stable, has the expected sign, and is significantly different from zero at either the 1, 5 or 10 percent levels of significance. In contrast, the effect of Y_d is less obvious. The sign of the regression coefficient for Y_d jumps from positive in 4.1, 4.2, 4.4 and 4.8 to negative in 4.3, 4.5 and 4.9. Note, however, that Y_d is never statistically significant in all of the equation tests. So, Y_d is rejected on statistical grounds.[5] Also worthy of special notice are the gasoline price and car size variables, P_g and S_c, respectively. In all of the equation tests, both P_g and S_c have neither the expected sign nor significant t-ratios.

The findings for P_g and S_c mean that neither gasoline price nor car size is sensitively linked to gasoline consumption. It supports the supposition of Blomqvist that consumer demand response to higher gasoline prices will have time lags (although this lag is not estimated in the study) because of the lifetime of the existing stock of cars and because of consumers' unwillingness to abandon subjective preferences.

On the other hand, it is reasonable to assume that larger cars consume more gasoline than small ones. Yet, the regression results for car size show a negative coefficient. The following hypothesis is formulated to explain this rather unpleasant result. The effect of car size on gasoline consumption could be outweighed by the intensity with which a small car is used. Since a smaller car has greater mileage per liter of gasoline owing to its greater fuel efficiency (than

4. Note, however, that when a regression equation fitting only Y_d has the independent variable as tested, the sign of the coefficient becomes negative and its t-ratio is not significant (please see 3.12).

5. The results for Y_d merit further investigation as it is a glaring underperformer in almost very case. Indeed, one may argue that perhaps more disaggregative data on disposable income (distinguishing between types of motorists or income levels) may make a difference. However, as the paper is really focusing on variables of interest to policy-makers such as the effects of gasoline prices rather than disposable income, and for reasons of space, no further attempt to either reexamine the results or redefine the variable Y_d is made.

a larger car), it may be driven more intensively by its owner, especially if it is his second car and, therefore, actually use more gasoline. This is testable but for reasons of space, the test is left as a future exercise. Suffice it to say that this explanation is consistent with Blomqvist's supposition that motorists meet the increase in fuel cost by curtailing expenditures it considers as more discretionary than car travel, at least in the short run. Hence, neither car size nor gasoline price will be a significant factor affecting gasoline consumption.

IV. SUMMARY AND CONCLUSIONS

The paper estimates a model of the market for cars that would throw some light on the composition of new car demand by size class. In particular, interest is focused on the role of actual changes in the price of gasoline in bringing about a shift toward smaller, more fuel-efficient cars, as well as their effect on gasoline consumption.

To this end, three separate demand equation models which distinguish between the demand for small cars (1300 cc or less), subcompact cars (from 1400 cc to 1600 cc) and "larger" cars (above 1700 cc) are estimated. In addition, the study also estimates a separate demand equation model for gasoline consumption.

The study's empirical tests, which are analyzed in Section III, lead to the conclusion that gasoline prices are not sensitively linked to gasoline consumption. Negative findings are discovered for the gasoline price variable in all of the equation tests, regardless of the model specification.

Variations in the price of gasoline, however, are found to have a negative effect on the demand for small cars. That is, as gasoline prices rise, purchases of small cars decline.

Car prices, on the other hand, are found to have a large positive effect on small cars and a large negative effect on the demand for subcompact (from 1400 cc to 1600 cc) cars. These findings suggest that, as the general prices of cars rise, there is a tendency to shift purchases towards smaller cars (1300 cc and below). This, however, is offset by the negative effect of P_g on small car purchases. To the extent that gasoline price hikes result in a decline in the real prices of cars, then the demand for small cars actually falls and that for the subcompact class rises.[6] The demand for large cars is found to be largely insulated from the effects of car and gasoline prices.

Caution should be exercised in drawing policy conclusions from the study's findings. First of all, the negative findings for gasoline price do not mean that gasoline price is unimportant. Rather, it implies that gasoline price operates almost entirely through the choice of cars and that the past variation in gasoline price has not been sufficient to induce a retrenchment in the gasoline usage of existing cars.

The negative effect of gasoline price, on the one hand, and the large positive effect of car prices on the demand for small cars, on the other imply a long-run effect on gasoline use. These findings suggest that optimum energy-use decisions should be governed more by a consideration of the higher real price of cars than the price of gasoline (via policies designed to influence the cost of car ownership, e.g., energy taxes and car registration fees) in order to sway car ownership towards smaller cars.[7]

Further work may use the study's estimates in making simulations under hypothetical policies designed to shift car demand to small cars, and to estimate the implied gasoline savings.

It is appropriate to end this paper with some suggestions about the ways in which the empirical model reported here might be improved. This paper estimates an aggregate demand function for new cars by size class, using the market-share approach. It would be helpful to estimate disaggregated demand functions for cars by size and age classes simultaneously. This type of model would simultaneously consider the factors which produce changes in the size of the stock of automobiles and the factors which produce changes in the rate of utilization of the existing stock of cars. The latter is not considered in this paper. Also, the inclusion of other factors that affect the consumers' ability to buy a new car such as credit conditions and credit availability would be interesting, in addition to income levels and prices.

Finally, a reformulation of the empirical model developed in the paper in the direction of a demand function based on stock demand

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6. P_c and P_g are negatively related. As P_g rises, P_c falls. This relationship (note that this does not imply cause and effect) is shown by the correlation matrix in Appendix Table 5.

7. The preliminary nature of the study's findings, and therefore its conclusions, should be emphasized, as the study's tests are based on a small sample of observations. It is possible that additional data could alter the present findings. However, policy decisions cannot wait until relationships become obvious.

APPENDIX TABLE 1
CAR DEMAND MODEL I

Equation no.	Equation	$\bar{R}^2$	F	Se	N	DW
1.1	$\ln M = 9.84 - 1.47 \ln Y_d + 3.09 \ln P_c^* - 0.37 \ln P_g - 1.77 \ln C_p$ (1.45) (5.09) (1.30) (1.79) [1.02] [0.61] [0.28] [0.99]	0.95	40.5	0.11	10	3.02
1.2	$\ln M = 2.38 + 0.09 \ln Y_d + 2.40 \ln P_c^* - 0.58 \ln P_g$ (.015) (4.38) (1.91) [0.61] [0.55] [0.30]	0.93	38.7	0.13	10	3.08
1.3.	$\ln M = 8.98 - 1.38 \ln Y_d + 3.34 \ln P_c^* - 2.30 \ln C_p^{***}$ (1.29) (5.46) (2.41) [1.07] [0.61] [0.95]	0.94	47.9	0.12	10	3.36
1.4	$\ln M = 9.87 + 1.92 \ln Y_d - 0.82 \ln P_g + 1.43 \ln C_p$ (1.02) (1.33) (0.82) [1.78] [0.61] [1.74]	0.72	8.8	0.25	10	1.87
1.5	$\ln M = 14 - 58 + 2.67 \ln Y_d + 0.76 \ln C_p$ (1.52) (0.43) [1.75] [1.75]	0.69	11.1	0.27	10	1.61
1.6	$\ln M = 1.28 + 2.53 \ln P_c^* - 0.34 \ln P_g - 0.54 \ln C_p$ (4.97) (1.11) (0.98) [0.51] [0.31] [0.55]	0.94	45.1	0.12	10	3.16
1.7	$\ln M = 1.46 + 2.79 \ln P_c^* - 1.10 \ln C_p^*$ (6.05) (4.91) [0.46] [0.22]	0.93	64.8*	0.12	10	3.16
1.8	$\ln M = 7.20 - 1.04 \ln P_g + 0.08 \ln C_p$ (1.81) (0.07) [0.57] [1.12]	0.72	12.6	0.25	10	1.30
1.9	$\ln M = 10.87 + 1.14 \ln Y_d^* + 2.47 \ln P_c^*$ (3.63) (3.85) [0.31] [0.64]	0.90	40.8*	0.15	10	2.91
1.10	$\ln M = 2.03 + 0.70 \ln Y_d - 0.671 \ln P_g$ (0.62) (1.17) [0.58] [0.12]	0.74	13.5	0.35	10	1.21
1.11	$\ln M = -1.74 + 2.42 \ln P_c^* - 0.62 \ln P_g^*$ (4.89) (5.02) [0.58] [0.12]	0.94	67.5*	0.12	10	3.05

* Statistically significant at the 1 percent level.
*** Statistically/significant at the 10 percent level.
T-ratios are in parentheses.
Standard errors are in brackets.
The DW statistic is not tested on account of the small number of degrees of freedom.
F-tests are done on acceptable functions only, i.e., 1.7, 1.9, 1.11.

for cars rather than its purchase would represent an improvement. This approach involves the recognition that consumers buy cars because of the flow of services that they generate, just like other durable goods.

APPENDIX TABLE 2
CAR DEMAND MODEL II

Equation no.	*Equation*	$\bar{R}^2$	*F*	*Se*	*N*	*DW*
2.1	$\ln M = 12.15 - 0.50 \ln Y_d - 1.76 \ln P_c^* + 0.13 \ln P_g - 0.12 \ln C_p$	0.95	40.8	.07	10	2.20
	(0.79) (4.64) (0.74) (0.19)					
	[0.63] [0.68] [0.18] [0.62]					
2.2	$\ln M = 11.35 - 0.40 \ln Y_d - 1.80 \ln P_c^* + 0.12 \ln P_g$	0.96	64.8	.06	10	2.16
	(1.34) (6.73) (.080					
	[0.30] [0.27] [0.15]					
2.3	$\ln M = 12.46 - 0.53 \ln Y_d - 1.84 \ln P_c^* + 0.07 \ln C_p$	0.95	58.5	.07	10	2.47
	(0.87) (5.32) (0.13)					
	[0.61] [0.35] [0.54]					
2.4	$\ln M = 22.79 - 2.37 \ln Y_d + 0.38 \ln P_g - 1.94 \ln C_p$	0.76	10.7	.15	10	1.81
	(2.30) (1.09) (1.93)					
	[1.03] [0.35] [1.00]					
2.5	$\ln M = 25.49 - 2.77 \ln Y_d - 1.62 \ln C_p$	0.76	15.0	.15	10	1.55
	(2.84) (1.67)					
	[0.97] [0.97]					
2.6	$\ln M = 8.38 - 1.95 \ln P_c^* + 0.14 \ln P_g + 0.30 \ln Cp$	0.95	57.8	.07	10	1.92
	(6.88) (0.82) (0.99)					
	[0.28] [0.17] [0.31]					
2.7	$\ln M = 8.45 - 2.05 \ln P_c^* + 0.53 \ln C_p$	0.95	90.5	.07	10	2.31
2.8	$\ln M = 1.85 + 0.68 \ln P_g - 0.17 \ln C_p$	0.62	82.6	.18	10	0.96
	(1.61) (0.21)					
	[0.42] [0.82]					
2.9	$\ln M = 13.08 - 0.61 \ln Y_d - 1.82 \ln P_c^*$	0.96	102.1	.06	10	2.50
	(4.80) (6.99)					
	[0.13] [0.26]					
2.10	$\ln M = 8.05 - 0.85 \ln Y_d + 0.19 \ln P_g$	0.67	10.2	.17	10	0.70
	(1.09) (0.46)					
	[0.78] [0.40]					
2.11	$\ln M = 8.63 - 1.88 \ln P_c^* + 0.30 \ln P_g$	0.95	86.5	.07	10	1.72
	(6.85) (4.31)					
	[0.28] [0.07]					
2.12	$\ln M = 10.74 - 1.19 \ln Y_d$	0.70	22.3	.161	10	0.77
	(4.72)					
2.13	$\ln M = 12.16 - 2.64 \ln P_c^*$	.94	48.25	.12	10	0.91
	(6.95)					
2.14	$\ln M = 1.57 + 0.59 \ln P_g$	.66	18.7	.17	10	0.87
	(4.32)					
2.15	$\ln M = 0.15 + 1.07 \ln C_p$	0.54	11.6	.20	10	0.76

* Statistically significant at the 1 percent level.
T-ratios are in parentheses.
Standard errors are in brackets.
The DW statistic is not tested on account of the small number of degrees of freedom.
F test is made on acceptable function only, i.e., 2.13.

APPENDIX TABLE 3
CAR DEMAND MODEL III

Equation no.	*Equation*	$\bar{R}^2$	*F*	*Se*	*N*	*DW*
3.1	$\ln M = 37.88 + 3.88 \ln Y_d + 1.34 \ln P_c + 0.98 \ln P_g + 2.94 \ln C_p$	0.41	2.58	.28	10	1.96
	(1.53) (0.89) (1.38) (1.20)					
	[2.53] [1.51] [0.70] [2.46]					
3.2	$\ln M = 17.61 + 1.28 \ln Y_d + 2.48 \ln P_c + 1.32 \ln P_g$	0.37	2.77	.29	10	2.07
	(0.95) (2.06) (1.99)					
	[1.34] [1.21] [0.67]					
3.3	$\ln M = 35.61 + 3.65 \ln Y_d + 0.60 \ln P_c + 4.43 \ln C_p$	0.32	2.44	.30	10	2.31
	(1.34) (0.45) (1.80)					
	[2.71] [1.54] [2.41]					
3.4	$\ln M = -45.97 + 5.30 \ln Y_d^{**} + 0.78 \ln P_g + 4.33 \ln C_p$	0.43	3.30	.27	10	2.30
	(2.77) (1.19) (2.32)					
	[1.92] [0.66] [1.87]					
3.5	$\ln M = -40.79 + 4.49 \ln Y_d^{**} + 4.97 \ln C_p$	0.40	3.01	.28	10	2.39
	(2.44) (2.71)					
	[1.84] [1.84]					
3.6	$\ln M = -8.57 + 2.81 \ln P_c + 0.90 \ln P_g - 0.30 \ln C_p$	0.28	2.17	.30	10	2.05
	(2.18) (1.16) (0.22)					
	[1.29] [0.78] [1.39]					
3.7	$\ln M = -8.09 + 2.13 \ln P_c + 1.18 \ln C_p$	0.25	2.46	.31	10	2.05
	(1.80) (2.05)					
	[1.18] [0.57]					
3.8	$\ln M = 0.83 + 0.13 \ln P_g + 0.38 \ln C_p$	–.10	0.58	0.38	10	1.73
	(0.15) (0.23)					
	[0.86] [1.68]					
3.9	$\ln M = 1.77 + 1.10 \ln Y_d + 2.32 \ln P_c$	0.11	1.54	0.34	10	2.02
	(1.58) (1.62)					
	[0.70] [1.62]					
3.10	$\ln M = 13.06 + 1.91 \ln Y_d + 1.23 \ln P_g$	0.08	1.39	0.34	10	1.53
	(1.21) (1.53)					
	[1.58] [0.80]					
3.11	$\ln M = -8.82 + 2.74 \ln P_c + 0.75 \ln P_g$	0.38	3.74	0.28	10	2.02
	(2.35) (2.57)					
	[1.17] [0.29]					
3.12	$\ln M = 4.75 - 0.36 \ln Y_d$	–.07	0.38	0.37	10	1.70
	(0.62)					
3.13	$\ln M = 0.10 + 0.83 \ln P_c$	–.06	0.50	0.37	10	1.45
	(0.71)					
3.14	$\ln M = 1.41 + 0.31 \ln P_g$	0.03	1.25	0.35	10	1.67
	(1.12)					
3.15	$\ln M = 0.51 + 0.62 \ln C_p$	0.03	1.28	0.35	10	1.77

**Statistically significant at the 5 percent level.
T-ratios are in brackets.
Standard errors are in brackets.
The DW statistic is not tested owing to the small number of degrees of freedom.

APPENDIX TABLE 4
MODEL OF GASOLINE DEMAND

Equation no.	*Equation*	$\bar{R}^2$	*F*	*Se*	*N*	*DW*
4.1	$\ln G = 10.31 + 0.97\ln Y_d + 0.24\ln P_g + 1.54\ln C_p^{***} - 0.03\ln S_c$	0.89	10.1	.08	10	2.28
	(1.67) (1.19) (2.75) (1.16)					
	[0.58] [0.20] [0.56] [0.02]					
4.2	$\ln G = -9.63 + 0.86\ln Y_d + 0.19\ln P_g + 1.57\ln C_p^{***}$	0.88	23.7	.08	10	1.61
	(1.46) (0.92) (2.73)					
	[0.59] [0.20] [0.57]					
4.3	$\ln G = 1.30 - 0.23\ln Y_d + 0.41\ln P_g - 0.03\ln S_c$	0.77	10.9	.12	10	1.75
	(0.41) (1.44) (0.88)					
	[0.56] [0.28] [0.04]					
4.4	$\ln G = -8.55 + 0.70\ln Y_d + 1.73\ln C_p^{**} - 0.025S_c$	.88	23.4	.08	10	2.37
	(1.27) (3.14) (0.87)					
	[0.56] [0.55] [0.02]					
4.5	$\ln G = 2.28 - 0.36\ln Y_d + 0.35\ln P_g$	0.78	16.6	0.12	10	1.52
	(0.69) (1.29)					
	[0.53] [0.27]					
4.6	$\ln G = 1.82 + 0.11\ln P_g + 0.84\ln C_p^{***} - 0.02\ln S_c$	0.86	18.9	.09	10	1.93
	(0.53) (1.99) (0.80)					
	[0.21] [0.42] [0.03]					
4.7	$\ln G = -2.12 + 1.05\ln C_p^{**} - 0.02\ln S_c$	0.87	31.5	.09	10	2.02
	(7.68) (0.75)					
	[0.14] [0.03]					
4.8	$\ln G = -8.33 + 0.67\ln Y_d + 1.72\ln C_p^{**}$	.88	35.9*	.08	10	1.80
	(1.23) (3.16)					
	[0.54] [0.04]					
4.9	$\ln G = 7.24 - 0.99\ln Y_d - 0.02\ln S_c$	9.73	13.3	.13	10	1,59
	(4.97) (0.52)					
	[0.20] [0.04]					
4.10	$\ln G = -1.99 + 0.08\ln P_g + 0.92\ln C_p^{***}$	0.86	29.6	.09	10	1.77
	(0.39) (2.31)					
	[0.20] [0.40]					
4.11	$\ln G = -0.42 + 0.51\ln P_g - 0.04\ln S_c$	0.80	18.56	0.11	10	1.77

**Statistically significant at the 5 percent level.
*** Statistically significant at the 10 percent level.
T-ratios are in parentheses.
Standard errors are in brackets.
The DW statistic is not tested owing to the small number of degrees of freedom.
F test is done on most acceptable function only, i.e., 4.8.